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PATENT
Atty. Docket No. MIT-075C2 (5473/79)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANTS: Massie et al. CONFIRMATION NO.: 3150
SERIAL NUMBER: 10/022,114 GROUP NUMBER: 2123
FILING DATE: November 16, 2001 EXAMINER: Not assigned
TITLE: Force Reflecting Haptic Interface

RESPONSE TO NOTICE TO FILE CORRECTED APPLICATION PAPERS

This paper is submitted in response to the Notice to file Corrected Application Papers mailed from the United States Patent Office on August 13, 2002. Prior to examination, please enter this Response and consider the accompanying remarks. Amend the application as follows, without prejudice.

In the Claims:

Cancel claim 63 and add claims 64-82 to read as follows. A copy of the claims commencing on a separate sheet in accordance with 37 CFR 1.75(h) is enclosed herewith.

64. (New) An apparatus for generating a signal representative of force, the apparatus comprising:

a receiver for receiving a signal representative of a location of a user reference point relative to a user reference frame;

a geometrical model storing:

a representation of a non-local reference frame;

the user reference frame in relation to the non-local reference frame; and

a conformation of a non-local environment, the conformation comprising a spring-type element relative to the non-local reference frame;

a comparator for comparing the location of the user reference point relative to the non-local environment; and

a force generator for generating a signal representative of a force based on the location of the user reference point relative to the non-local environment and at least one force rule.

65. (New) The apparatus of claim 64, wherein the at least one force rule comprises a spring-force rule which specifies an output force signal in response to a location signal of the user reference point indicative of a deflected conformation of the spring-type element.

66. (New) The apparatus of claim 65, wherein the output force signal is specified by a non-linear function.

67. (New) The apparatus of claim 64, further comprising a non-local environment reaction calculator that makes changes to the representation of the conformation of the non-local environment based on the signal representative of force and the at least one force rule.

68. (New) The apparatus of claim 67, wherein the at least one force rule specifies a change in a representation of the conformation of the non-local environment in response to a location signal of the user reference point indicative of a deflected conformation of the spring-type element.

69. (New) The apparatus of claim 64, wherein the spring-type element is selected from the group consisting of a switch element and a diagonal element.

70. (New) The apparatus of claim 69, wherein the switch element is selected from the group consisting of a virtual push-button and a virtual toggle-type switch.

71. (New) The apparatus of claim 69, wherein the diagonal element is selected from the group consisting of a brush, a sponge, and an eraser.

72. (New) The apparatus of claim 71, further comprising a non-local environment reaction calculator that makes changes to the representation of the conformation of the non-local environment based on the signal representative of force and the at least one force rule, wherein a diagonal element spring-type rule specifies a change in a representation of a cross-sectional area of a selected region of the diagonal element.

73. (New) A method for generating a signal representative of force, the method comprising the steps of:

receiving a signal representative of a location of a user reference point relative to a user reference frame;

storing a representation of:
a non-local reference frame,
the user reference frame in relation to the non-local reference frame; and
a conformation of a non-local environment, the conformation comprising a
spring-type element relative to the non-local reference frame;
comparing the location of the user reference point relative to the non-local environment;
and
generating a signal representative of a force based on the location of the user reference
point relative to the non-local environment and at least one force rule.

74. (New) The method of claim 73 further comprising the step of changing a representation
of the conformation of the non-local environment based on the signal representative of force and
the at least one force rule.

75. (New) The method of claim 74, further comprising the step of displaying on a visual
display the representation of the conformation of the non-local environment as the representation
changes over time.

76. (New) A force reflecting haptic interface comprising:
an electro-mechanical device comprising:
a connection element for physically coupling to a user;
an actuator including an encoder; and
a linkage mechanism coupling the connection element to the actuator;
an electrical input/output device; and
a control apparatus for generating an output force signal and an output position signal.

77. (New) The interface of claim 76, wherein the linkage mechanism comprises a series of
rotary elements.

78. (New) The interface of claim 76, wherein the linkage mechanism comprises a five-bar
linkage.

79. (New) The interface of claim 76, wherein the actuator comprises a rotary actuator.

80. (New) The interface of claim 76, wherein the electro-mechanical device converts an input force signal and an input position signal to a torque value and an angle measurement, respectively.

81. (New) The interface of claim 76, wherein the control apparatus comprises a computer.

82. (New) The interface of claim 76, wherein the control apparatus generates the output force signal based at least in part on an electrical signal that represents an amount of torque the actuator applies in a local environment.

REMARKS

The claims are hereby amended to begin the claims on a separate sheet in accordance with 37 CFR 1.75(h). New claims 64-82 are supported at least at page 31, line 3, to page 38, line 21, and FIGS. 5, 12, and 13. No new matter has been added.

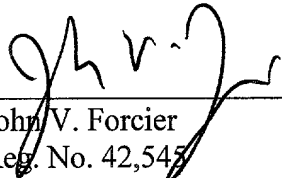
CONCLUSION

Applicants respectfully request entry of this Response prior to examination of the application on the merits. The Examiner is invited to contact Applicants' undersigned representative by telephone at the number listed below to discuss any outstanding issues.

Respectfully submitted,

Date: October 15, 2002

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Claims

64. (New) An apparatus for generating a signal representative of force, the apparatus comprising:
- a receiver for receiving a signal representative of a location of a user reference point relative to a user reference frame;
 - a geometrical model storing:
 - a representation of a non-local reference frame;
 - the user reference frame in relation to the non-local reference frame; and
 - a conformation of a non-local environment, the conformation comprising a spring-type element relative to the non-local reference frame;
 - a comparator for comparing the location of the user reference point relative to the non-local environment; and
 - a force generator for generating a signal representative of a force based on the location of the user reference point relative to the non-local environment and at least one force rule.
65. (New) The apparatus of claim 64, wherein the at least one force rule comprises a spring-force rule which specifies an output force signal in response to a location signal of the user reference point indicative of a deflected conformation of the spring-type element.
66. (New) The apparatus of claim 65, wherein the output force signal is specified by a non-linear function.
67. (New) The apparatus of claim 64, further comprising a non-local environment reaction calculator that makes changes to the representation of the conformation of the non-local environment based on the signal representative of force and the at least one force rule.
68. (New) The apparatus of claim 67, wherein the at least one force rule specifies a change in a representation of the conformation of the non-local environment in response to a location signal of the user reference point indicative of a deflected conformation of the spring-type element.
69. (New) The apparatus of claim 64, wherein the spring-type element is selected from the group consisting of a switch element and a diagonal element.
70. (New) The apparatus of claim 69, wherein the switch element is selected from the group consisting of a virtual push-button and a virtual toggle-type switch.

71. (New) The apparatus of claim 69, wherein the diagonal element is selected from the group consisting of a brush, a sponge, and an eraser.

72. (New) The apparatus of claim 71, further comprising a non-local environment reaction calculator that makes changes to the representation of the conformation of the non-local environment based on the signal representative of force and the at least one force rule, wherein a diagonal element spring-type rule specifies a change in a representation of a cross-sectional area of a selected region of the diagonal element.

73. (New) A method for generating a signal representative of force, the method comprising the steps of:

- receiving a signal representative of a location of a user reference point relative to a user reference frame;

- storing a representation of:

- a non-local reference frame,

- the user reference frame in relation to the non-local reference frame; and

- a conformation of a non-local environment, the conformation comprising a spring-type element relative to the non-local reference frame;

- comparing the location of the user reference point relative to the non-local environment;

- and

- generating a signal representative of a force based on the location of the user reference point relative to the non-local environment and at least one force rule.

74. (New) The method of claim 73 further comprising the step of changing a representation of the conformation of the non-local environment based on the signal representative of force and the at least one force rule.

75. (New) The method of claim 74, further comprising the step of displaying on a visual display the representation of the conformation of the non-local environment as the representation changes over time.

76. (New) A force reflecting haptic interface comprising:

- an electro-mechanical device comprising:

- a connection element for physically coupling to a user;

an actuator including an encoder; and
a linkage mechanism coupling the connection element to the actuator;
an electrical input/output device; and
a control apparatus for generating an output force signal and an output position signal.

77. (New) The interface of claim 76, wherein the linkage mechanism comprises a series of rotary elements.

78. (New) The interface of claim 76, wherein the linkage mechanism comprises a five-bar linkage.

79. (New) The interface of claim 76, wherein the actuator comprises a rotary actuator.

80. (New) The interface of claim 76, wherein the electro-mechanical device converts an input force signal and an input position signal to a torque value and an angle measurement, respectively.

81. (New) The interface of claim 76, wherein the control apparatus comprises a computer.

82. (New) The interface of claim 76, wherein the control apparatus generates the output force signal based at least in part on an electrical signal that represents an amount of torque the actuator applies in a local environment.